**M.S. Work for Reinforcement**

2.12.1 General The steel reinforcement shall be prepared and fixed in accordance with the Working Drawings furnished by the Engineer. This work shall consist of furnishing and placing bars of the grade, type and size shown in accordance with these specifications and in conformity with the requirements shown on the Drawings The Contractor shall provide the Engineer with bar bending schedules detailing the reinforcement required for the Permanent Works. Such schedules are to be approved by the Engineer prior to the commencement of work. Approval shall not relieve the Contractor from his responsibilities under the Contract for providing the materials called for on the Drawings. All further working drawings and lists of reinforcement necessary to carry out the Works shall be provided by the Contractor at his own cost. All reinforcement delivered to the site shall be stacked prior to use off the ground and kept free from dirt, oil, grease and avoidable rust.

**2.12.2**

**Steel Reinforcement**

Reinforcement bars shall be mild steel made from billet structural grade of 60 and shall conform to following specifications. (1) Code or standard

|  |  |
| --- | --- |
| (1) Code or Standard | Standard of equivalent code: ASTM A575, A615  Grade 60 |
| (2) Physical Properties | Yield Stress - 414 N/mm2 minimum  Tensile Stress - 483 N/mm2 minimum  Percentage elongation - 20% minimum.  (min. gauge length-5 dia). |
| (3) Standard Dimensions and Weight | According to table 2.13.1 |
| (4) Dimensional tolerance | Below 28mm bar +/-0.5mm  Above 28mm bar +/-0.6mm |
| (5) Weight tolerance | The difference between calculated Weight and actual  shall be within +/-3.5% |

Reinforcing Steel shall be deformed bar. All reinforcement bars shall be Mild Steel made from **Billet Structural Grade of 60** and shall conform to following specifications. Test will be carried out for each fresh consignment and at the frequencies as per directions of the Engineer.

**Table 2.12.2 Dimension & Weight:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bar Diameter** | | **Cross Sectional**  **Area** | | **Perimeter** | | **Unit Weight** | |
| **in** | **Mm** | **in2** | **nm2** | **in** | **Mm** | **ib/ft** | **kg/m** |
| **1/4** | **6.35**  **6** | **0.05** | **28.27** | **0.79** | **18.85** | **0.167** | **0.249**  **0.22** |
| **5/16** | **7.94**  **8** | **0.07** | **50.26** | **0.98** | **25.13** | **0.261** | **0.370**  **0.395** |
| **3/8** | **9.525**  **10** | **0.11** | **78.54** | **1.18** | **31.42** | **0.376** | **0.56**  **0.62** |
| **1/2** | **12.70**  **12** | **0.20** | **113.10** | **1.57** | **37.70** | **0.668** | **0.99**  **0.89** |
| **5/8** | **15.875**  **16** | **0.31** | **201.06** | **1.96** | **50.27** | **1.043** | **1.56**  **1.58** |
| **3/4** | **19.05**  **20** | **0.44** | **283.53** | **2.36** | **59.69** | **1.502** | **2.24**  **2.23** |
| **7/8** | **22.23**  **22** | **0.60** | **380.13** | **2.75** | **69.12** | **2.044** | **3.05**  **2.98** |
| **1** | **25.40**  **25** | **0.79** | **490.87** | **3.14** | **78.54** | **2.670** | **3.98**  **3.85** |
| **1-1/8** | **28.65**  **28** | **1.00** | **615.75** | **3.54** | **87.96** | **3.400** | **5.06**  **4.83** |
| **1-1/4** | **31.75**  **32** | **1.27** | **804.25** | **3.99** | **100.53** | **4.303** | **6.42**  **6.31** |

**2.12.3 Cutting and Bending**

All cutting and bending shall be in accordance with standard approved practice. Straightening of bends and re-bending of incorrectly bent bars shall not be permitted. Bars shall be bent cold by use of an approved bending machine. Bending radii shall be as specified on the drawings with bends made round a former having a diameter of at least three times the diameter of the bar. If the radii are not shown on the Drawings, ACI standards shall be followed. Where splices or overlapping in reinforcement are required the bars shall, unless otherwise shown on the Drawings, have an overlap of not less than thirty times the diameter where a U-hook is employed on each of the overlapping bars and forty-five times the diameter for bars without hooks.

**2.12.4 Placing and Fixing Reinforcing Steel**

**All reinforcement shall be securely and accurately fixed in position shown on the drawings using** approved spacer blocks and chairs. Tolerance allowance for placing reinforcement shall not exceed 12mm. No splices of reinforcement shall be made other than as shown on the Drawings or approved by the Engineer All intersections of bars shall be secured with No 22 to 18 gauge galvanized iron wire, the ends being turned into the body of the concrete. The reinforcement shall be held securely in place to the lines and grades shown on the Drawings by approved concrete supports, spacers or ties with particular care being taken during placing of the concrete. The specified concrete cover as shown in the drawing to reinforcement shall be maintained with the aid of approved supports and spacer pieces. Top reinforcement in slabs shall be maintained in position by means of chairs made out of mild steel, the diameter and quantity being sufficient to ensure security of the reinforcement shall be used to support access ways, working platforms, or the placing equipment or for the conducting of an electric current. Reinforcement supports and spacers shall be sufficient to maintain reinforcement in place throughout the concreting operation and shall not be exposed on the concrete face or discolor the finished concrete. Before any steel reinforcement is embedded in the concrete any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete which may adhere to the exposed bars during concreting operations shall be removed.

**2.12.5 Concrete Cover to Reinforcement**

Unless specified on the Drawings, the clear concrete cover to reinforcement shall be as tabulated below:

**Table 2.12.5 Clear concrete cover to reinforcement**

|  |  |  |
| --- | --- | --- |
| **Description of Concrete Element** | **Clear Cover (mm)** | |
| **Normal Exposure** | **Saline Water** |
| Wall and floor slab: - Contact with earth  - Exposed to weather and water  Regulator Pier  Regulator Deck Slab  Railing | **60**  **50**  **50**  **40**  **25** | **75**  **60**  **60**  **40**  **25** |

Cover shall be maintained by the use of the minimum practical number of purpose made concrete blocks, approved spacers and reinforcement chairs. Concrete spacer blocks shall be made from cement, sand and small aggregate to match the mix proportions of the surrounding concrete as far as practical to ensure comparable strength, durability and appearance.

**2.12.6 Splicing**

Reinforcing shall be furnished in the lengths indicated on the Drawings. When the Contractor wishes to use more splices than are indicated and / or necessary, the Contractors shall furnish Working Drawings to the Engineers for approval in accordance with the guidelines provided on the Contract Drawings. If such additional splices are approved, the extra weight occasions by such splices shall be included in the measurement of reinforcement for payment.

All splices for high yield deformed steel bars and mild steel plain steel bars shall have lap lengths as shown on the Drawings. Lap splices shall generally be located at points of minimum tension in bars, Except where otherwise shown on the Drawings lap splices shall be made with the bars placed in control and security wired together.

**2.12.7 Welding of Reinforcement**

Reinforcement which is specified to be welded shall be welded by any process the Contractor can demonstrate by bend and tensile tests which will ensure that the strength of the parent metal is not reduced and that the weld possesses strength no less than that of the parent metal. The welding procedure established by the successful test weld shall be maintained and no departure from this procedure shall be permitted. Following the establishment of satisfactory welding procedures, each welder to be employed on the work shall carry out welder performance qualification tests on reinforcing bars of the same metal and size as those on the works.

**2.12.8 Dowel Bar and Cap**

Where shown on the Drawings, dowel bars shall be incorporated in movement joints and bridge bearings. The dowel bars shall be a round mild steel bar of the diameter and length indicated on the Drawings and the top of the bar shall be covered with an approved dowel cap. The capped end of the dowel bar shall be sawn square; bar cropping will not be permitted.

Where dowel bars are to be provided through movement joints the part of the bar to be free to move shall be coated with an approved bond breaking bitumen paint and fitted with a compressible cap. The cap shall be of such a diameter to provide a sliding fit on the bar and of length indicated on the Drawings. The cap shall be partially filled with approved compressible filler

**2.12.9 Measurement**

The quantity of reinforcement to be measured under this Section shall be computed as weight in kilograms and accepted as shown on the Drawings provided that the quantity shall not include the reinforcement in any item of work for which the basis of payment include the reinforcement. In computing the weight to be measured, the theoretical weights of bars of the cross section shown in the Drawings shall be used. The weight shall be calculated based on a constant mass of 0.00785 kg/mm per metre run.

The computed weight shall not include the extra material incurred when bars larger than those specified are used, or the extra material necessary for splices when bars shorter than those specified are used with permission of the Engineer, or the weight of any devices used to support or fasten the reinforcement in the correct position including any necessary chairs

**2.12.10 Payment**

Payment shall be made in kg as per unit rate included in BoQ Item. The rate shall include all cost of material including cutting, binding, welding, providing Dowel bar etc.